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EXAMINER	
ZARNEKE, DAVID A	

ART UNIT	PAPER NUMBER
2829	

DATE MAILED: 03/02/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/762,764	XI ET AL.	
	Examiner	Art Unit	
	David A. Zarneke	2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 December 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-33* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/27/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Double Patenting

The terminal disclaimer filed 12/27/04 over US Patent 6,551,929 has been approved by the Patent Office. As a result, the double patenting rejection is overcome.

Response to Arguments

Applicant's arguments filed 12/27/04 have been fully considered but they are not persuasive.

Essentially applicant argues that Kang does not teach forming a bulk deposition layer on the barrier layer using vapor deposition. Kang does teach depositing a metal layer but fails to teach how it is deposited or that it is deposited on the barrier layer.

The examiner asserts that Kang (6, 13+) teaches forming a metal line made of AL or W using CVD. While not explicitly teaching that the metal line is formed over the barrier layer, Kang implicitly teaches this because where else is the metal line to be deposited (MPEP 2112). Kang is directed towards forming barrier layers in a contact hole. A skilled artisan implicitly knows that the metal lines are deposited upon the barrier layers in the contact hole.

Therefore, the rejections of the previous office action stand as written. Newly added claims 15-33 are rejected below.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) *the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.*

Claims 1, 2, and 4 are rejected under 35 U.S.C. 102(e) as being anticipated by Kang et al., U.S. Patent 6,139,700.

Kang teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising:

a) forming a refractory metal nucleation layer, WN, by serially exposing said substrate to first and second reactive gases (claim 16); and

b) forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases (6, 13+).

Regarding claim 2, Kang teaches the bulk deposition layer is deposited using chemical vapor deposition ((6, 13+).

With respect to claim 4, Kang teaches the forming of the nucleation layer further includes introducing a purge gas into the processing chamber after exposing said substrate to the first reactive gas and before exposing said substrate to said second reactive gas (Kang, claim 7).

Claims 10-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Kang et al., U.S. Patent 6,139,700.

Kang teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate, said method comprising:

serially exposing said substrate to first and second reactive gases, wherein said second reactive gas comprises a refractory metal selected from the group consisting of titanium (Ti) and tungsten (W), while said substrate is disposed in a processing chamber, to form a nucleation layer (claim 16);

removing from said processing chamber said first reactive gas before exposing said substrate to said second reactive gas (5, 38+); and

forming said layer adjacent to said nucleation layer by chemical vapor deposition while said substrate is disposed in said processing chamber by concurrently exposing said nucleation layer to said second reactive gas and a reducing agent (4, 17+).

Regarding claim 11, Kang teaches the reducing agent to be silane (4, 17+).

With respect to claim 12, Kang teaches the use of W (4, 41+).

As to claim 13, Kang teaches the final step of the ALD process to be a purge to remove any byproducts (5, 30-56).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> *(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the*

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 3, 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 1 above.

Regarding claim 3, while Kang fails to teach the bulk deposition layer is deposited employing physical vapor deposition, it would have been obvious to one of ordinary skill in the art to replace CVD with PVD because they are both conventionally accepted methods used to deposit refractory metal nucleation layers.

the examiner takes "official notice" since the claimed subject matter is notoriously well-known in the art (MPEP 2144.03). The formation of a layer by reducing a refractory metal containing gas with silane is a standard, notoriously well-known method of depositing a metal layer.

As to claim 5, while Kang does teach forming a nucleation layer further includes purging said processing chamber of said first reactive gas by using a degassing chamber said processing chamber clear of all gases disposed therein before introducing said second reactive gas (6, 13+), Kang fails to teach using a pump to do this.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a pump in the degassing chamber of Kang because pumps are conventional devices used to purge chambers. The use of conventional materials to perform there known functions in a conventional process is obvious (MPEP 2144.07).

In re claim 6, while Kang does teach forming the refractory metal nucleation layer further includes purging said processing chamber of said first reactive gas by introducing a purge gas and subsequently degassing said processing chamber clear of all gases disposed therein before exposing said substrate to said second reactive gas Kang fails to teach using a pump to do this.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a pump in the degassing chamber of Kang because pumps are conventional devices used to purge chambers. The use of conventional materials to perform there known functions in a conventional process is obvious (MPEP 2144.07).

Claims 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 1 above, and further in view of Kang et al., U.S. Patent 6,287,965.

Kang '700 fails to teach the use of boron-containing compound such as diborane to form the nucleation layer.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by diborane or any other B compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily surmise that a B-compound would be used to supply the boron to the layer.

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

As to claim 9, both Kang references teach the use of Ar or N_2 purge gases ('700:5, 46+ & '965: 8, 55+) between chemisorption of each monolayer (see claims of both).

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 10 above.

While Kang fails to specify the nucleation layer thickness, it would have been obvious to one ordinary skill in the art at the time of the invention to optimize the nucleation layer thickness (MPEP 2144.05(b)).

Claim 15-18, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700.

Kang teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate having a via, said method comprising:

a) forming a refractory metal nucleation layer, WN, by serially exposing said substrate to first and second reactive gases (claim 16), wherein the refractory metal nucleation layer covers the via; and

b) forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases, wherein the bulk deposition layer fills the via (6, 13+).

As discussed above, while Kang fails to explicitly teach the bulk deposition layer filling the via, Kang implicitly teaches filling the via by stating that a metal line is formed (6, 13+).

Further, Kang fails to teach the use of a plurality of vias.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a plurality of vias in the invention of Kang because the mere duplication

of parts has no patentable significance unless a new and unexpected result is produced (In re Harza, 124 USPQ 378 (CCPA 1960)).

Regarding claim 16, Kang teaches the refractory metal is tungsten (2, 65+).

With respect to claim 17, Kang teaches the bulk deposition layer is deposited using chemical vapor deposition ((6, 13+).

As to claim 18, while Kang teaches the use of a separate chambers within a transfer chamber, It would have been obvious to one of ordinary skill in the art at the time of the invention to use a single chamber because the performance of two steps simultaneously, which have previously been performed in sequence was held to have been obvious [In re Tatincloux 108 USPQ 125 (CCPA 1955)].

In re claim 20, Kang teaches the use of WF_6 (2, 65+).

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700 (Kang 700), as applied to claim 19 above, and further in view of Kang et al., U.S. Patent 6,287,965 (Kang 965).

Kang 700 fails to teach the first reactive gas is diborane.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by diborane or any other B compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art

could then easily surmise that a B-compound would be used to supply the boron to the layer.

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85.USPQ 328 (USSC 1950).

Claims 21, 22, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 1 above.

Regarding claims 21 and 24, Kang teaches exposing the substrate to the first reactive gas; exposing the substrate to a second reactive gas; and repeating these steps (2, 55+).

As to the period of time and the "pulse", which the examiner is assuming means the same as "a period of time" because there is nothing in the specification providing a definition or time limit for "pulse", Kang teaches exposing the substrate to the gases, and therefore it inherently is exposed for both a period of time and a pulse.

In re the second exposing the substrate to the first reactive gas step, Kang teaches repeating the steps of exposing the substrate to both the first and second reactive gas (2, 55+, step (g)). Since the present claims use comprising language the addition of a further step of exposing the substrate to the second reactive gas after the pulse of the first reactive gas is permissible (MPEP 2111.03).

With respect to claims 22 and 25, it would have been obvious to one of ordinary skill in the art to optimize the period of time through routine experimentation (MPEP 2144.05(b)).

Claims 23 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claims 21 and 24 above respectively, and further in view of Kang et al., U.S. Patent 6,287,965.

Kang '700, which teaches the use of a tungsten-containing compound (2, 65+), fails to teach the use of boron-containing compound to form the nucleation layer.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by a B-containing compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily surmise that a B-compound would be used to supply the boron to the layer.

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Claims 27, 28, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 1 above.

Regarding claim 27, while Kang fails to teach exposing the substrate to the first reactive gas for a period of time to form a first layer prior to forming the refractory metal nucleation layer, it would have been obvious to one of ordinary skill in the art at the time of the invention to form what essentially is a seed layer for the refractory metal nucleation layer because seed layers are used known to be used to aid in the adhesion of the refractory metal nucleation layer to the underlying substrate.

With respect to claim 28, Kang teaches a cycle comprising sequentially exposing the substrate to the first reactive gas for a period of time; and a second cycle sequentially exposing the substrate to the second reactive gas and the first reactive gas. and repeating these steps (2, 55+).

In re the second exposing the substrate to the first reactive gas step, Kang teaches repeating the steps of exposing the substrate to both the first and second reactive gas (2, 55+, step (g)). since the present claims use comprising language the addition of a further step of exposing the substrate to the second reactive gas after the pulse of the first reactive gas is permissible (MPEP 2111.03).

With respect to claim 29, it would have been obvious to one of ordinary skill in the art to optimize the period of time through routine experimentation (MPEP 2144.05(b)).

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 28 above, and further in view of Kang et al., U.S. Patent 6,287,965.

Kang '700, which teaches the use of a tungsten-containing compound (2, 65+), fails to teach the use of boron-containing compound to form the nucleation layer.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by a B-containing compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily surmise that a B-compound would be used to supply the boron to the layer.

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Claims 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 1 above.

With respect to claim 31, Kang teaches a cycle comprising sequentially exposing the substrate to the first reactive gas for a period of time; and a second cycle sequentially exposing the substrate to the second reactive gas and the first reactive gas. and repeating these steps (2, 55+).

In re the second exposing the substrate to the first reactive gas step, Kang teaches repeating the steps of exposing the substrate to both the first and second

reactive gas (2, 55+, step (g)). since the present claims use comprising language the addition of a further step of exposing the substrate to the second reactive gas after the pulse of the first reactive gas is permissible (MPEP 2111.03).

With respect to claim 32, it would have been obvious to one of ordinary skill in the art to optimize the period of time through routine experimentation (MPEP 2144.05(b)).

Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 31 above, and further in view of Kang et al., U.S. Patent 6,287,965.

Kang '700, which teaches the use of a tungsten-containing compound (2, 65+), fails to teach the use of boron-containing compound to form the nucleation layer.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by a B-containing compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily surmise that a B-compound would be used to supply the boron to the layer.

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin

125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David A. Zarneke whose telephone number is (571)-272-1937. The examiner can normally be reached on M-F 7:30 AM-6 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Baumeister can be reached on (571)-272-1712. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David A. Zarneke
Primary Examiner
February 22, 2005